

## 5.0 Major Design Features of the Recommended Alternative

### 5.1 Introduction

This chapter will explore the major design features associated with the recommended alternative. The recommended alternatives for the mainline and Table Mesa TI are described in Chapter 4 and shown on the plan sheets in Appendices C and D, respectively.

### 5.2 Design Controls

The new lanes in the I-17 corridor will be designed to meet current ADOT and AASHTO design criteria. The proposed typical section will consist of 12-foot travel lanes, ten-foot inside shoulders, ten-foot outside shoulders, and two-foot offsets to barriers. A two-foot HOV buffer will be included between the HOV lane and inside general use lane. Existing horizontal and vertical alignments will be matched. New cross slopes will be constructed to 0.02 ft/ft. Areas of deficient superelevation will be regraded to conform to current design standards. Some of the existing pavement may be re-used, matching the existing cross slopes of 0.015 to 0.02 ft/ft in those sections. Auxiliary lanes will be added between interchanges with spacings of 1.5 miles or less (Deer Valley and Pinnacle Peak, Pinnacle Peak and Happy Valley, Happy Valley and Jomax (future TI), Carefree Highway and Pioneer, Pioneer and Daisy Mountain, and Daisy Mountain and Anthem Way).

The functional classification for I-17 is Principal Arterial Interstate – Urban from MP 214.5 to 218.8 and Principal Arterial Interstate – Rural from MP 218.8 to 244.5. The existing "urban boundary" is located at approximately Happy Valley Road (MP 218). However, a significant amount of development is projected to occur in the corridor by the design year 2025. It is anticipated that the corridor will be mostly urbanized from Anthem Way (MP 229) to the south. Therefore, design criteria listed in Table 18 below reflect different values for the projected urban and rural sections of the corridor.

The following design controls were used for the development of the recommended I-17 corridor layout:

**TABLE 18 – DESIGN CONTROLS FOR MAINLINE I-17 WIDENING**

DESCRIPTION OF CRITERION	VALUE FOR DESIGN
Design Year	2025
Design Speed:	
Mainline (MP 214.5 to 224) (Urban, level terrain)	75 mph desirable; match existing horizontal and vertical alignments
Mainline (MP 224 to 229) (Urban, rolling terrain)	75 mph desirable; match existing horizontal and vertical alignments
Mainline (MP 229 to 244.5) (Rural, rolling terrain)	75 mph desirable; match existing horizontal and vertical alignments
Ramp Gore with Mainline	65 mph
Body of Ramp	50 mph
Superelevation	
MP 214.5 to 229	0.06 ft/ft max.
MP 229 to 244.5	0.10 ft./ft. max.
Lane Width	12 ft.
Outside Shoulder Width	10 ft. + 2 ft. offset to barrier
Inside Shoulder Width	10 ft. + 2 ft. offset to barrier (8 ft. shoulder permitted in urban areas)
Auxiliary Lane	12 ft.; include when TIs are spaced at 1.5 miles or less
HOV Buffer	2 ft.
Maximum Degree of Curve	
MP 214.5 to 229	2°30'
MP 229 to 244.5	3°00'

DESCRIPTION OF CRITERION	VALUE FOR DESIGN
Maximum Gradient MP 214.5 to 229 MP 229 to 244.5	3%; match existing vertical alignment 4%; match existing vertical alignment
Normal Cross Slope	1.5% - 2.0%
Taper Rate MP 214.5 to 229 MP 229 to 244.5	75:1 75:1
Minimum Vertical Clearance: Highway Traffic Structure	16.5 ft. (16.0 ft. over PCCP)
Type of Access Control	Full access control. Access control line is 300 ft. beyond ramp return on cross road.
Deer Valley Road TI NB Exit Ramp Design Speed Width Maximum Degree of Curve Maximum Gradient	25 mph 24 ft. 25° 4% upgrade desirable, 5% downgrade desirable, 6% maximum
Frontage Roads Design Speed Width Maximum Gradient Normal Cross Slope	50 mph 12 ft. lanes, 2 ft. shoulders + 2 ft. offset to barrier 7% maximum for rural non-divided (match existing) 2%
Table Mesa TI Ramps/Cross Road Ramp Design Speed Cross Road Design Speed Ramp Width Maximum Degree of Curve Maximum Gradient Ramps Cross Road Superelevation Normal Cross Slope	65 mph at gore, 50 mph through body, 35 mph at cross road 40 mph minimum 22 ft. (one-lane ramp) 6° desirable, 8°15' maximum 4% upgrade desirable, 5% downgrade desirable, 6% maximum 3% adjacent to ramp terminus 0.10 ft./ft. max. 2.0%

FHWA's 1996 Hydraulic Engineering Circular No. 22, *Urban Drainage Design Manual*, recommends that on multi-lane highways where three or more lanes are sloped in the same direction, it is desirable to facilitate pavement drainage by increasing the cross slope of the outermost lanes. It recommends that the two lanes adjacent to the crown line should be pitched at the normal cross slope (1.5–2.0%) and successive lane pairs outward, or portions thereof, should be increased by 0.5 to 1 percent. The maximum pavement cross slope should be limited to four percent. The final designer should evaluate increases in cross slope with respect to drainage considerations, driver comfort and safety, and maintaining clearance over existing pipes.

### 5.3 Horizontal and Vertical Alignments

**Through I-17/SR 101L TI:** The recommended alignment widens I-17 by adding one lane in each direction through the I-17/SR 101L TI, beginning near the Yorkshire bridge in the northbound direction and south of Union Hills Drive in the southbound direction. Near Rose Garden Lane, two general use lanes and an HOV are added in each direction for a total section of 5+1.

**North of Rose Garden Lane to North of Deer Valley:** Three general use lanes plus an HOV lane will be added in this segment, for a total of five general use lanes and an HOV lane (5+1) in each direction. One-way frontage roads exist on both sides of I-17. The west frontage road will not be disturbed with the addition of barrier between the mainline and the frontage road. The east frontage road will require relocation outward. No auxiliary lanes are provided since two SR 101L lanes are added northbound and two are dropped southbound under Rose Garden. To increase the northbound weaving length from I-17 and the SR 101L ramps to the Deer Valley Road TI exit, the existing diamond-type ramp will be removed and replaced by a loop ramp in the northeast quadrant of the interchange.

**North of Deer Valley to Skunk Creek:** A 5+1 section will also be provided in this segment of I-17. On the east side of I-17, the frontage road will be separated from the mainline by 18 feet. On the west side, the frontage road will be separated from the mainline by a drainage channel. Auxiliary lanes are provided in both directions from Deer Valley to Happy Valley and space for future auxiliary lanes is provided in both directions from Happy Valley to Jomax.

**Skunk Creek to North of the CAP:** The concrete-lined channel on the east side is not required north of Skunk Creek; however, a channel is provided between the mainline and frontage roads on both sides of I-17.

The 5+1 mainline section will continue in this segment of I-17. From Dynamite to the CAP, a new subdivision is located on the west side of I-17 adjacent to the existing three-lane frontage road. To avoid impacts to the subdivision and its existing screen wall, barrier is recommended between the mainline and frontage road on the west side through this section. Space for an auxiliary lane will become available when the existing frontage road is converted to one-way and narrowed to 28 feet. On the east side, a full section was applied, including provision for a future auxiliary lane.

**North of the CAP to Carefree Highway:** The 5+1 section will be extended north to Carefree Highway. Full widths are employed with ditches and width for a future auxiliary lane in both directions. The City of Phoenix plans to extend one-way frontage roads from Dixileta to Carefree Highway as future development warrants.

**Carefree Highway to New River TI:** From the Carefree Highway TI north to the New River TI, a 4+1 section will be provided, plus auxiliary lanes from the Pioneer Road TI to the Daisy Mountain TI and from the Daisy Mountain TI to the Anthem TI. The existing frontage roads between Anthem Way and the New River TI will remain in their current locations.

**North of the New River TI,** the northbound and southbound alignments bifurcate. Due to the presence of physical constraints on both sides of the existing alignments, widening will consist of a combination of inside and outside widening (see Tables 15 and 16). The HOV lane is dropped at the New River TI and a 4+0 section extends north to the Black Canyon City TI, the northern study limit. From the New River TI to the Black Canyon City TI, widening is to the inside or outside as reflected in the following tables. Horizontal curves are used for transitions.

**TABLE 19 – NORTHBOUND WIDENING NORTH OF NEW RIVER TI**

From MP	To MP	Widening to Inside or Outside
232.5	237.1	Inside
237.7	239.7	Outside
240.1	242.0	Centered on Existing
242.3	244.5	Inside

**TABLE 20 – SOUTHBOUND WIDENING NORTH OF NEW RIVER TI**

From MP	To MP	Widening to Inside or Outside
232.6	234.3	Outside
235.5	237.1	Inside
237.7	240.7	Outside
241.4	244.5	Inside

Plan sheets for the recommended alternative are presented in Appendix C. The 1" = 200' scale plans provide preliminary horizontal design for the recommended alternative. Geometric data is shown for the existing and modified mainline I-17 curves. Existing horizontal geometry is matched south of the New River TI and north of the Rock Springs TI.

Because the addition of lanes requires widening the existing facility, existing profile grades will be matched in many locations. Where the northbound and southbound profiles between SR 101L and Carefree Highway are not identical, one of the profiles will be adjusted to provide a single profile for the northbound and southbound roadways where possible. Typically, the southbound profile will be raised to match the northbound profile; however, elevation changes will be constrained by vertical clearance requirements, right-of-way, existing OP bridge grades, and drainage requirements. The existing I-17 corridor profile data is tabulated below.

**TABLE 21 – I-17 VERTICAL ALIGNMENT DATA**

VPI Station	VPI Elevation	Approach Grade %	Departure Grade %	Curve Length	Curve Type
731+67.50 NB	1380.03	0.444	0.449	GB	GB
739+00.00 SB	1383.34	0.444	0.460	GB	GB
764+00.00 NB	1394.84	0.460	0.335	1000.00	Crest
764+00.00 SB	1394.84	0.460	0.335	1000.00	Crest
776+00.00 NB	1398.86	0.335	0.213	GB	GB
776+00.00 SB	1398.86	0.335	0.196	GB	GB
783+00.00 NB	1400.35	0.213	0.414	GB	GB
783+00.00 SB	1400.23	0.196	0.194	GB	GB
788+00.00 NB	1402.42	0.414	0.189	GB	GB
798+00.00 NB	1404.31	0.189	0.332	GB	GB
806+50.00 SB	1404.79	0.194	0.220	GB	GB
816+50.00 SB	1406.49	0.220	0.550	400.00	Sag
826+50.00 SB	1411.99	0.550	0.000	500.00	Crest
832+00.00 NB	1415.61	0.332	-0.130	1000.00	Crest
851+50.00 SB	1411.99	0.000	0.620	800.00	Sag
852+00.00 NB	1412.99	-0.130	0.678	800.00	Sag
874+00.00 NB	1427.92	0.678	0.400	800.00	Crest
886+00.00 NB	1432.72	0.400	0.560	800.00	Sag
903+50.00 SB	1440.01	0.380	0.740	400.00	Sag
905+00.00 NB	1443.35	0.560	0.532	GB	GB
912+00.00 SB	1446.30	0.740	0.250	600.00	Crest
924+00.00 SB	1449.30	0.250	0.900	800.00	Sag
932+00.00 SB	1456.50	0.900	0.580	400.00	Crest
957+00.00 NB	1471.00	0.532	0.500	GB	GB
957+00.00 SB	1471.00	0.580	0.500	GB	GB
981+00.00 NB	1483.00	0.500	0.958	800.00	Sag

VPI Station	VPI Elevation	Approach Grade %	Departure Grade %	Curve Length	Curve Type
981+00.00 SB	1483.00	0.500	0.840	400.00	Sag
996+00.00 SB	1495.60	0.840	1.155	400.00	Sag
1005+00.00 NB	1506.00	0.958	0.633	800.00	Crest
1005+00.00 SB	1506.00	1.155	0.500	1000.00	Crest
1021+00.00 SB	1514.00	0.500	0.786	600.00	Sag
1035+00.00 NB	1525.00	0.633	0.872	GB	GB
1035+00.00 SB	1525.00	0.786	0.872	GB	GB
1054+00.00 SB	1542.00	0.872	0.706	GB	GB
1065+00.00 NB	1551.16	0.872	0.848	GB	GB
1066+00.00 SB	1551.00	0.783	0.706	GB	GB
1083+00.00 SB	1563.00	0.706	1.000	600.00	Sag
1093+00.00 SB	1573.00	1.000	0.810	GB	GB
1099+00.00 NB	1580.00	0.848	0.806	GB	GB
1135+00.00 NB	1609.00	0.806	0.833	GB	GB
1135+00.00 SB	1607.00	0.810	0.867	GB	GB
1150+00.00 SB	1620.00	0.867	0.800	GB	GB
1170+00.00 SB	1636.00	0.800	0.560	GB	GB
1171+00.00 NB	1639.00	0.833	0.533	800.00	Crest
1186+00.00 NB	1647.00	0.533	1.000	800.00	Sag
1189+00.00 SB	1646.00	0.560	1.262	400.00	Sag
1198+00.00 SB	1658.00	1.262	0.529	800.00	Crest
1202+00.00 NB	1663.00	1.000	0.320	800.00	Crest
1215+00.00 SB	1667.00	0.529	0.292	400.00	Crest
1226+00.00 NB	1670.68	0.320	0.755	600.00	Sag
1227+00.00 SB	1670.50	0.292	0.770	400.00	Sag
1239+00.00 SB	1679.74	0.770	0.179	800.00	Crest
1241+00.00 NB	1682.00	0.755	0.211	800.00	Crest
1260+00.00 NB	1686.00	0.211	1.168	800.00	Sag
1260+00.00 SB	1683.50	0.179	1.152	800.00	Sag
1283+00.00 NB	1713.00	1.168	2.727	800.00	Sag
1283+00.00 SB	1710.00	1.152	2.680	800.00	Sag
1310+50.00 NB	1788.00	2.727	-2.566	2800.00	Crest
1311+00.00 SB	1785.00	2.680	-2.500	2800.00	Crest
1335+50.00 NB	1723.86	-2.566	-0.179	1600.00	Sag
1337+00.00 SB	1720.00	-2.500	-0.222	1200.00	Sag
1355+00.00 NB	1720.36	-0.179	2.000	800.00	Sag
1355+00.00 SB	1716.00	-0.222	1.680	1200.00	Sag
1366+50.00 NB	1743.36	2.000	-0.259	1000.00	Crest
1368+00.00 SB	1737.84	1.680	-0.320	800.00	Crest
1375+50.00 SB	1735.44	-0.320	0.000	400.00	Sag
1381+50.00 SB	1735.44	0.000	1.480	600.00	Sag
1384+00.00 NB	1738.96	-0.259	1.482	800.00	Sag
1393+50.00 SB	1753.20	1.480	0.778	1200.00	Crest
1395+50.00 NB	1756.00	1.482	0.800	800.00	Crest
1407+00.00 SB	1763.70	0.778	1.300	700.00	Sag
1409+00.00 NB	1767.00	0.800	1.310	800.00	Sag
1457+00.00 NB	1826.00	1.167	1.818	800.00	Sag

VPI Station	VPI Elevation	Approach Grade %	Departure Grade %	Curve Length	Curve Type
1457+00.00 SB	1825.00	1.205	1.867	400.00	Sag
1497+00.00 SB	1896.00	1.759	1.333	800.00	Crest
1500+00.00 NB	1902.00	1.750	0.833	1000.00	Crest
1512+00.00 NB	1912.00	0.833	1.550	800.00	Sag
1513+00.00 SB	1913.20	0.920	1.600	400.00	Sag
1557+00.00 SB	1975.00	1.273	0.333	1000.00	Crest
1557+50.00 NB	1977.50	1.353	0.153	1400.00	Crest
1574+00.00 NB	1978.78	0.169	-0.589	800.00	Crest
1574+00.00 SB	1980.38	0.448	-0.669	800.00	Crest
1594+00.00 NB	1967.00	-0.589	0.300	1000.00	Sag
1594+00.00 SB	1967.00	-0.669	0.158	800.00	Sag
1613+00.00 SB	1970.00	0.158	3.000	1600.00	Sag
1614+00.00 NB	1973.00	0.300	2.900	1600.00	Sag
1650+00.00 NB	2077.00	2.900	-1.070	1200.00	Crest
1650+00.00 SB	2081.00	3.000	-0.955	1200.00	Crest
1670+00.00 NB	2056.00	-1.070	2.000	800.00	Sag
1672+00.00 SB	2060.00	-0.955	2.941	800.00	Sag
1689+00.00 SB	2110.00	2.941	1.286	800.00	Crest
1694+00.00 NB	2104.00	2.000	-1.412	1000.00	Crest
1711+00.00 NB	2080.00	-1.412	1.727	800.00	Sag
1722+00.00 NB	2099.00	1.727	1.300	800.00	Crest
1731+00.00 SB	2164.00	1.286	-2.000	1000.00	Crest
1736+50.00 NB	2115.35	1.300	0.250	1000.00	Crest
1747+50.00 NB	2119.10	0.250	3.500	800.00	Sag
1748+00.00 SB	2130.00	-2.000	2.667	800.00	Sag
1760+00.00 NB	2162.85	3.500	-0.173	1600.00	Crest
1763+00.00 SB	2170.00	2.667	1.250	800.00	Crest
1775+00.00 NB	2160.25	-0.173	1.750	800.00	Sag
1775+00.00 SB	2185.00	1.250	2.710	800.00	Sag
1788+00.00 NB	2183.00	1.750	1.237	600.00	Crest
1806+00.00 SB	2269.00	2.710	-1.484	1400.00	Crest
1807+00.00 NB	2206.50	1.237	-0.433	1000.00	Crest
1822+00.00 NB	2200.00	-0.433	1.357	800.00	Sag
1837+00.00 SB	2223.00	-1.484	3.000	800.00	Sag
1838+00.00 NB	2221.68	1.357	2.558	1000.00	Sag
1853+00.00 SB	2271.00	3.000	-2.958	1700.00	Crest
1855+00.00 NB	2265.17	2.558	-2.158	1900.00	Crest
1877+00.00 NB	2217.70	-2.158	1.194	800.00	Sag
1877+00.00 SB	2200.00	-2.958	-1.600	800.00	Sag
1894+00.00 NB	2238.00	1.194	-1.000	800.00	Crest
1902+00.00 SB	2160.00	-1.600	-1.000	600.00	Sag
1907+00.00 NB	2225.00	-1.000	1.042	800.00	Sag
1918+00.00 SB	2144.00	-1.000	-0.241	600.00	Sag
1931+00.00 NB	2250.00	1.042	-5.000	1600.00	Crest
1947+00.00 SB	2137.00	-0.241	-3.000	1200.00	Crest
1979+00.00 NB	2010.00	-5.000	0.175	800.00	Sag
1988+00.00 SB	2014.00	-3.000	-5.167	1000.00	Crest

VPI Station	VPI Elevation	Approach Grade %	Departure Grade %	Curve Length	Curve Type
2000+00.00 SB	1952.00	-5.167	1.571	800.00	Sag
2014+00.00 SB	1974.00	1.571	-0.875	1100.00	Crest
2022+00.00 SB	1967.00	-0.875	1.077	500.00	Sag
2035+00.00 SB	1981.00	1.077	-2.813	1600.00	Crest
2036+00.00 NB	2020.00	0.175	-1.667	800.00	Crest
2051+00.00 SB	1936.00	-2.813	2.833	700.00	Sag
2054+00.00 NB	1990.00	-1.667	3.793	1000.00	Sag
2063+00.00 SB	1970.00	2.833	2.488	600.00	Crest
2083+00.00 NB	2100.00	3.793	-3.182	2000.00	Crest
2083+00.00 SB	2019.76	2.488	-0.238	1200.00	Crest
2105+00.00 NB	2030.00	-3.182	2.571	1000.00	Sag
2106+50.00 SB	2014.16	-0.238	2.735	800.00	Sag
2119+50.00 SB	2049.53	2.735	-1.059	1600.00	Crest
2137+00.00 SB	2031.00	-1.059	0.241	600.00	Sag
2140+00.00 NB	2120.00	2.571	-2.500	4300.00	Crest
2142+00.00 SB	2036.00	0.241	-1.227	800.00	Crest
2153+00.00 SB	2022.50	-1.227	2.500	1000.00	Sag
2171+00.00 NB	2042.50	-2.500	1.021	800.00	Sag
2172+00.00 SB	2070.00	2.500	-1.650	1600.00	Crest
2190+00.00 NB	2061.90	1.021	-1.650	800.00	Crest
2187+00.00 NB	2045.25	-1.650	-0.328	800.00	Sag
2187+00.00 SB	2045.25	-1.650	-0.328	800.00	Sag
2203+00.00 NB	2040.00	-0.328	-1.905	800.00	Crest
2203+00.00 SB	2040.00	-0.328	-1.905	800.00	Crest
2224+00.00 NB	2000.00	-1.905	-0.150	800.00	Sag
2224+00.00 SB	2000.00	-1.905	-0.150	800.00	Sag
2244+00.00 NB	1997.00	-0.150	2.005	800.00	Sag
2244+00.00 SB	1997.00	-0.150	2.051	800.00	Sag
2280+00.00 NB	2070.00	2.005	0.292	1600.00	Crest
2280+00.00 SB	2070.00	2.051	0.292	1600.00	Crest
2303+72.42 NB	2076.93	0.292	3.500	1600.00	Sag
2304+34.85 SB	2077.10	0.292	3.500	1600.00	Sag

There are several mainline segments north of Carefree Highway in which the northbound and southbound profiles are different. Where the profile differential results in an elevation difference at the median barrier of zero to three feet, the standard ADOT detail should be used. Table 22 below details roadway sections in which the elevation difference at the median barrier exceeds three feet. A special detail should be developed during final design to address these areas.

**TABLE 22 – ELEVATION DIFFERENCES AT MEDIAN BARRIER**

From	Station To	Approximate Elevation Difference	Description
1282+00	1307+00	3' - 4'	South of Pioneer TI
1336+00	1382+00	4' - 7'	Between Pioneer TI and Deadman Wash

Preliminary horizontal alignments and profiles for the Table Mesa TI are included in Appendix D.

## 5.4 Access

I-17 is an access-controlled facility. There are no planned changes of access for I-17 associated with this project except where frontage roads require new openings in the access control line where they merge with/diverge from ramps and at the Table Mesa TI. Change of Access Reports will be prepared to address these changes.

## 5.5 Right-of-Way

New right-of-way will be required for the addition of lanes and drainage features between MP 215 and MP 232 as detailed in Table 23. The estimated right-of-way acquisition is approximately 63 acres of land, which includes the recommended Table Mesa TI alternative. Current major landowners include Arizona State Land Department, United States Automobile Association (USAA), Baha Properties LLC, Minnesota Title and Trust, and Harris Black Canyon Freeway Joint Venture LLC.

**North of Rose Garden Lane to North of Deer Valley:** The east frontage road will require relocation outward and the acquisition of approximately 18 feet of R/W with the addition of barrier between the mainline and the frontage road and the standard 15 feet spacing between the frontage road and new R/W line.

**North of Deer Valley to Scatter Wash:** Approximately 30 feet of new R/W will be required on the east side in order to relocate the frontage road. Onsite drainage will be conveyed through an underground system through this section in order to minimize R/W acquisition. Approximately 60 feet of R/W will be required on the west side where a ditch for onsite drainage will lie between the mainline and the relocated frontage road. A detention basin approximately 6.7 acres in size will be constructed on the west side of I-17 in this segment. Two entire parcels plus a majority of two other parcels will be needed for this basin. These parcels are noted (\*\*) in the New R/W Width column in Table 23.

**Scatter Wash to Skunk Creek:** The new right-of-way requirement will be 79-91 feet on the east side, with some land required from the USAA property. The new R/W will include a concrete-lined drainage channel used to convey drainage to Scatter Wash and a proposed two-acre detention basin, which is currently sited to the north of the existing development on the east side of I-17. Approximately 60 feet of R/W will be required on the west side, which will include the drainage ditch between the mainline and relocated frontage road. Between Pinnacle Peak Road and Happy Valley Road, ADOT will only purchase right-of-way area that is necessary to construct the drainage channels (13' on the west side and 33' – 45' on the east side). The City of Phoenix will be responsible for additional R/W used to construct frontage roads between the two interchanges. Parcels that lie within these areas have a (\*) notation in the New R/W Width column in the table below.

As described earlier in this report, ADOT is currently discussing reductions in R/W acquisition with two property owners on the east side of I-17 between Pinnacle Peak Road and Jomax Road. In order to maximize the developable property, Vestar (Pinnacle Peak to Happy Valley) and USAA (Happy Valley to Jomax) have requested that ADOT limit its R/W acquisition to 30 feet and construct a closed drainage system rather than a large drainage channel in these areas. USAA would construct a detention basin/storm drain system to collect and route storm water east of Norterra Parkway to the south and would provide 100-year 2-hour retention for the area located west of Norterra Parkway in accordance with City of Phoenix criteria. Vestar would be responsible for intercepting and re-routing all overland flow to prevent it from reaching ADOT R/W. These proposed reductions in R/W are not reflected in Table 23.

**Skunk Creek to South of Dynamite:** Approximately 56 feet of R/W will be required on the east side and 30 feet on the west side. A shallow drainage channel used to convey onsite flows will be constructed between the mainline and frontage roads on both sides.



**South of Dynamite to North of the CAP:** No new R/W will be required on the west side. Onsite drainage will be carried through an underground storm drain system in order to avoid taking R/W through the existing subdivision. On the east side, approximately 52 - 68 feet of new R/W will be required with an onsite drainage ditch between the mainline and frontage road.

**North of the CAP to Dixileta:** Approximately 52 feet of new R/W will be required on the east side and 60 feet on the west side. The roadway section will include onsite drainage channels between the mainline and frontage road on both sides of I-17.

**North of Dixileta to Carefree Highway:** Approximately 60 feet of new R/W will be required on the east side and 52 feet on the west side. This section will also employ onsite drainage channels on both sides between the frontage road and mainline I-17. At this location, ADOT will only purchase right-of-way area that is necessary to construct the drainage channels (5 feet on the west side and 13 feet on the east side). The City of Phoenix will be responsible for additional R/W required to construct frontage roads through this portion of the study. Parcels that lie within these areas have a (\*) notation in the New R/W Width column in the table below. The frontage road R/W for which the City is responsible is excluded from Table 23.

**Carefree Highway to New River TI:** No new right-of-way is required to accommodate the proposed roadway cross section from Carefree Highway to Anthem Way. The existing frontage roads between Anthem Way and the New River TI will remain in their current locations. However, a drainage channel will be added on the outside of the frontage roads on both sides of I-17. This will require 34 feet of R/W on the east side and 30 feet of R/W on the west side.

**TABLE 23 – NEW RIGHT-OF-WAY REQUIREMENTS**

Township	Range	Section	NB/ SB	Begin Station	End Station	New R/W Width	Area Req'd (acres)	Owner	Parcel No.
4N	2E	24	NB	781+17	782+38	Varies	0.030	Roger C & Margaret Harris	209-07-052
			NB	782+38	782+89	11'	0.013	Pauline A. Harris	209-07-050
			NB	782+89	783+39	Varies	0.013	Pauline A. Harris	209-07-051
			NB	783+39	783+91	12'	0.014	Pauline A. Harris	209-07-046
			NB	783+91	785+41	Varies	0.045	Deer Valley Plumbing Contractors Inc. et. al.	209-07-047
			NB	785+41	786+91	Varies	0.031	Stahl Family Farms LLC	209-07-045G
			NB	786+91	789+11	Varies	0.087	Freeway Mini Storage Co	209-07-045R
			NB	789+11	790+07	Varies	0.029	Freeway Mini Storage Co	209-07-045D
4N	2E	13	SB	805+26	806+73	Varies	0.001	Freeway Interchange Ltd Partnership	209-04-048B
			SB	807+32	810+22	Varies	0.141	Leisure Wheels Inc	209-04-047A
			NB	808+36	810+04	Varies	0.011	George/Francine/Donald Koldoff	209-04-034A
			NB	810+04	813+08	Varies	0.009	JJ's I-17 Opportunities Inc	209-04-035B
			SB	810+22	813+29	Varies	0.173	Arizona State Land Dept	209-04-046
			SB	813+93	816+95	20'	0.139	Happy New Deer LLC	209-04-045

Township	Range	Section	NB/ SB	Begin Station	End Station	New R/W Width	Area Req'd (acres)	Owner	Parcel No.
			SB	816+95	820+19	20'	0.146	Happy New Deer LLC	209-04-044
			SB	820+78	824+02	**	2.449	Mitchell K. Grauer	209-04-043B
			SB	820+78	824+02	**	0.893	John Brent & Denise Bowen	209-04-043A
			SB	824+02	826+76	**	1.649	RLE3 LLC	209-04-042
			NB	827+00	833+25	30'-91'	0.803	Dakar Enterprises Inc	209-03-011
			SB	827+70	831+32	**	1.658	John E/Mary/G Kasper Maynarich	209-03-005A
			SB	831+32	834+06	60'	0.374	TLE LLC	209-03-005B
			NB	833+25	839+48	91'	1.339	Haugen Enterprises	209-03-010
			SB	834+06	839+97	60'	0.827	Kent Myers etal	209-03-006
			NB	839+48	845+98	Varies	0.125	Haugen Enterprises	209-03-012
			SB	839+97	846+81	Varies	0.325	Rose F Weite	209-03-007A
			NB	845+98	852+57	Varies	0.119	Ernest M Linsemeyer	209-03-009
4N	2E	12	NB	853+11	858+00	Varies	0.013	Arizona State Lands Dept	Unassessed
			NB	860+88	866+26	Varies	0.226	Arizona State Lands Dept	Unassessed
			NB	866+26	894+94	Varies *	2.338	Arizona State Lands Dept	Unassessed
			SB	866+72	893+91	13' *	0.813	Arizona State Lands Dept	Unassessed
5N	2E	36	NB	923+98	954+28	79'	4.768	USAA	210-04-06
			SB	925+29	954+74	60'	3.966	Arizona State Lands Dept	Unassessed
5N	2E	35	NB	954+28	957+26	67'	0.463	Kent/Leslie Bowerbank Trust	205-04-016A
			SB	954+90	957+90	30'	0.208	Robert G. Knox	205-04-016B
			NB	957+26	960+60	67'	0.514	Kent/Leslie Bowerbank Trust	205-04-013
			SB	957+90	960+19	30'	0.086	Dennis D & Carol F Rezek & Robert G Knox	205-04-012
			SB	960+19	961+24	30'	0.146	Robert G. Knox	205-04-029A
			NB	960+60	963+94	67'	0.514	No Owner	205-04-022
			SB	961+24	964+58	30'	0.231	FCD of Maricopa Co.	205-04-033
			NB	963+94	967+28	Varies	0.343	Maricopa Co. FCD	205-04-005
			SB	964+58	966+87	30'	0.165	FCD of Maricopa Co.	205-04-030A
			SB	966+87	967+82	30'	0.066	Richard/Patricia Pingitore	205-04-030B
			NB	967+28	970+59	22'	0.171	Maricopa Co. FCD	205-04-027
			SB	967+82	971+26	30'	0.231	Richard/Patricia Pingitore	205-04-024
			NB	970+62	973+96	Varies	0.230	Leroy Peterson	205-04-008A
			SB	971+26	974+55	30'	0.226	Mark D. Schultz	205-04-018
			NB	973+96	975+30	Varies	0.117	Leroy Peterson	205-04-010A

Township	Range	Section	NB/ SB	Begin Station	End Station	New R/W Width	Area Req'd (acres)	Owner	Parcel No.
			SB	974+55	977+94	30'	0.235	Dorothy Marie Filipi	205-04-003
			NB	975+30	977+31	Varies	0.202	Leroy Peterson	205-04-010B
			NB	977+31	980+65	Varies	0.397	Leroy Peterson	205-04-009
5N	2E	35	SB	977+94	980+95	Varies	0.190	Alexander J. & James E. Lewus Trust	205-04-011
			NB	980+65	989+95	Varies	0.721	Sunstorm Enterprises Inc.	205-01-010C
			SB	981+62	984+61	Varies	0.120	Surinder/Rajinder Sanhan	205-01-004A
			SB	984+61	987+96	Varies	0.050	Surinder/Rajinder Sanhan	205-01-008
			NB	987+63	994+30	56'	0.857	Sunstorm Enterprises Inc.	205-01-003B
			NB	994+32	995+44	68'	0.174	Sunstorm Enterprises Inc.	205-01-011E
			NB	995+44	997+40	68'	0.306	James R & Margaret McDonald	205-01-011F
			NB	997+40	1001+85	68'	0.697	James R & Margaret McDonald	205-01-012
			NB	1001+85	1007+72	68'	0.917	Jackson A & Mercedes Mason	205-01-001D
5N	2E	26	NB	1007+72	1011+74	68'	0.627	The Prescott Valley Co.	204-23-001
			NB	1011+74	1024+64	68'	2.025	Minnesota Title & Trust	204-23-009S
			SB	1026+00	1027+48	10'	0.034	Arizona District Council of the Assemblies of God	204-23-009Y
			NB	1025+29	1030+51	68'	0.818	Interstate 17 Investment Partners	204-23-009R
			SB	1027+48	1030+26	10'	0.064	Arizona Public Service	204-23-009X
			SB	1030+26	1031+18	10'	0.021	US Bureau of Reclamation	204-23-009W
			NB	1030+51	1034+45	68'	0.537	United States of America	204-23-009N
			SB	1031+18	1034+94	Varies	0.087	United States of America	204-23-009E
			NB	1034+45	1038+16	52'	0.452	US Bureau of Reclamation	204-23-005D
			SB	1034+94	1041+63	Varies	0.240	George T Pingitore	204-23-006C
			NB	1038+16	1039+67	52'	0.180	US Bureau of Reclamation	204-23-005F
			NB	1039+67	1047+84	52'	0.970	TMN Limited Partnership	204-23-005E
			SB	1041+63	1048+33	Varies (26' – 50')	0.585	Harris Black Canyon Freeway Joint Venture	204-23-006A
			NB	1047+84	1060+62	52'	1.529	City of Phoenix	204-23-011
			SB	1048+33	1061+80	60'	1.827	Harris Black Canyon Freeway Joint Venture	204-23-004

Township	Range	Section	NB/ SB	Begin Station	End Station	New R/W Width	Area Req'd (acres)	Owner	Parcel No.
5N	2E	23	NB	1061+15	1069+59	13' *	0.095	City of Phoenix	204-14-001
			SB	1063+28	1116+09	Varies (5' to 13') *	0.743	Arizona State Land Department	Unassessed
			NB	1069+59	1115+43	13' *	1.344	Arizona State Land Department	Unassessed
5N	2E	14	NB	1115+43	1169+96	13' *	1.612	Arizona State Land Department	Unassessed
			SB	1116+09	1169+75	5' *	0.626	Arizona State Land Department	Unassessed
5N	2E	11	SB	1169+75	1204+74	5' *	0.309	Arizona State Land Department	Unassessed
			NB	1170+04	1172+00	13' *	0.061	Tramonto Development LLC	204-02-004B
			NB	1172+00	1195+57	13' *	0.708	Baha Properties LLC	204-02-004
			NB	1196+03	1206+78	13' *	0.275	Arizona State Land Department	Unassessed
6N	2E	10	SB	1500+76	1511+00	30'	0.672	City of Phoenix	202-22-006A
			NB	1503+69	1517+72	Varies	1.233	Anthem Arizona LLC	202-22-013F
			SB	1511+00	1516+99	30'	0.413	Anthem Arizona LLC	202-22-009E
			SB	1516+99	1523+16	30'	0.326	John G/ Patricia Ann Pingitore	202-22-009C
			NB	1517+72	1538+91	34'	1.667	Phoenix-Yuma LLC	202-22-014
			SB	1523+16	1528+25	30'	0.346	John G/ Patricia Ann Pingitore	202-22-016
			SB	1528+25	1529+74	30'	0.104	ISC Holdings LLC	202-22-017
			SB	1529+74	1530+65	30'	0.063	ISC Holdings LLC	202-22-019
			SB	1530+65	1533+11	30'	0.170	Transwestern Investments LLC	202-22-009Z
			SB	1533+11	1534+13	30'	0.070	Transwestern Investments LLC	202-22-009P
			SB	1534+13	1537+54	30'	0.236	James W/Karen E Gesell	202-22-009R
			SB	1537+54	1540+97	30'	0.238	Dabney Properties LLC	202-22-021
			NB	1539+21	1545+15	34'	0.465	Mary G Sheehan Trust	202-22-015A
			SB	1540+97	1545+69	30'	0.327	Sherry J Ward	202-22-007
6N	2E	3	NB	1545+55	1549+65	34'	0.318	Phoenix North Corridor Development Co.	202-22-002C
			SB	1545+69	1572+00	30'	1.820	Joseph P Reid Family Limited Partnership II et al	202-22-003C
			NB	1549+65	1553+19	34'	0.276	Phoenix North Corridor Development Co.	202-22-002B
			NB	1553+19	1558+03	34'	0.376	NWB Inc.	202-22-003M
			NB	1558+03	1560+52	34'	0.192	George T Pingitore	202-02-003L
			NB	1560+52	1564+33	34'	0.295	Alvin K/Kathryn L Harris et al	202-02-003D
			NB	1564+33	1566+43	34'	0.150	International Sunprints II LLC	202-02-003J

Township	Range	Section	NB/ SB	Begin Station	End Station	New R/W Width	Area Req'd (acres)	Owner	Parcel No.
			NB	1566+43	1568+38	34'	0.152	Olive L Smith Trust	202-02-003F
			NB	1568+38	1570+35	34'	0.154	Terry M Schumacher Trust	202-02-003G
			NB	1570+35	1572+35	34'	0.156	Terry M Schumacher Trust	202-02-003H
			SB	1572+00	1588+60	Varies	0.710	Sun-Up Ranch LLC	202-22-001E
			NB	1572+32	1576+40	34'	0.317	Terry M Schumacher Trust	202-02-001C
			NB	1576+40	1586+57	34'	0.665	New Hamburg Land Company	202-22-001D
7N	2E	11	NB	1849+00	1856+50	Varies	1.500	Arizona State Land Dept	Unassessed
R/W for Drainage Extensions:									
4N	2E	13	SB	813+67	814+07	20'	0.018	Happy New Deer LLC	209-04-045
		13	NB	813+69	814+09	20'	0.018	Kim & Carol Wong	209-04-036
		13	SB	831+33	831+80	50'	0.040	TLE LLC	209-03-005B
4N	2E	13	SB	840+15	840+95	40'	0.073	Rose F Weite	209-03-007A
5N	2E	26	NB	1054+29	1054+69	20'	0.018	City of Phoenix	204-23-011
5N	2E	26	SB	1054+30	1054+70	20'	0.018	Harris Black Canyon Freeway Joint Venture	204-23-004
5N	2E	23	SB	1065+78	1066+18	20'	0.018		Unassessed
5N	2E	23	NB	1065+81	1066+21	20'	0.018	City of Phoenix	204-14-001
5N	2E	23	SB	1072+78	1073+18	20'	0.018		Unassessed
5N	2E	23	NB	1072+81	1073+21	20'	0.018		Unassessed
5N	2E	23	NB	1080+76	1081+16	16'	0.018		Unassessed
5N	2E	23	SB	1081+71	1082+11	20'	0.018		Unassessed
5N	2E	23	NB	1094+76	1095+16	20'	0.018		Unassessed
5N	2E	23	SB	1113+80	1114+20	20'	0.018		Unassessed
5N	2E	23	NB	1113+80	1114+20	20'	0.018		Unassessed
5N	2E	14	NB	1119+72	1120+12	20'	0.018		Unassessed
5N	2E	14	SB	1119+80	1120+20	20'	0.018		Unassessed
5N	2E	14	NB	1137+23	1137+63	20'	0.018		Unassessed
5N	2E	14	SB	1137+30	1137+70	20'	0.018		Unassessed
5N	2E	11	SB	1178+00	1178+80	40'	0.073		Unassessed
5N	2E	11	NB	1180+41	1181+21	40'	0.073	Baha Properties LLC	204-02-004
5N	2E	11	SB	1189+52	1189+92	20'	0.018		Unassessed
5N	2E	11	NB	1190+89	1191+29	20'	0.018	Baha Properties LLC	204-02-004
7N	2E	27	SB	1675+31	1676+00	33'	0.053		Unassessed
7N	2E	22	SB	1738+08	1738+52	47'	0.047		Unassessed
7N	2E	15	SB	1777+62	1778+32	45'	0.072		Unassessed
7N	2E	15	SB	1798+56	1798+99	30'	0.030		Unassessed

Township	Range	Section	NB/ SB	Begin Station	End Station	New R/W Width	Area Req'd (acres)	Owner	Parcel No.
7N	2E	20	SB	1818+80	1819+22	23'	0.022		Unassessed
8N	2E	35	NB	1946+28	1946+72	35'	0.035		Unassessed
8N	2E	35	NB	1947+86	1948+29	44'	0.043		Unassessed
8N	2E	35	NB	1954+92	1955+32	22'	0.020		Unassessed
8N	2E	26	NB	1991+99	1992+39	27'	0.025		Unassessed
8N	2E	26	NB	1995+71	1996+61	31'	0.064		Unassessed
8N	2E	22	NB	2048+96	2049+61	33'	0.049		Unassessed
8N	2E	22	NB	2061+58	2062+35	37'	0.064		Unassessed
8N	2E	22	NB	2090+59	2091+19	40'	0.056		Unassessed
8N	2E	15	NB	2139+28	2139+68	28'	0.026		Unassessed
<b>TOTAL</b>							<b>62.5</b>	<b>ACRES</b>	

Approximately 1.5 acres of R/W will be necessary to construct the recommended alternative (Alternative #8) at the Table Mesa TI.

ADOT Right-of-Way Group researched warranty deed information to determine what access rights to the existing frontage roads between Happy Valley Road and Dixileta Drive are held by adjacent property owners. They found that of 21 original property owners, nine have clear rights to "access to a two-way frontage road" and eight warranty deeds contain language that could be construed to imply access to a two-way frontage road. Converting two-way frontage roads to one-way frontage roads would require an acceptable alternate access route and would likely include the purchase of access rights from these property owners.

Some culvert extensions will require permanent drainage easements (PDE) or acquisition of right-of-way. Thirteen culverts between Deer Valley Road TI and Carefree Highway will likely require new right-of-way. Additionally, fourteen culverts between the New River Interchange and the Rock Springs Interchange will require right-of-way to accomplish the necessary improvements. New right-of-way is required where pipe or box culvert extensions and/or headwalls extend beyond the existing right-of-way. A sufficient area of new right-of-way considers the need for maintenance access to the culvert.

PDEs will likely be needed for upstream and/or downstream channel grading at many culvert locations. PDEs will need to be established during the final design process. They were not delineated in the study since detailed topographic information was not available during this phase.

Right-of-way lines shown on the drawings in the Appendices are based on limits of disturbance identified by the conceptual design layout and do not indicate the final right-of-way requirements or easements necessary for construction. Actual limits will be established during the final design process.

There are a number of section corners in the project area which are in or near the roadway. The monuments shall be preserved or replaced if disturbed by construction.

## 5.6 Drainage Considerations

A preliminary drainage report was prepared for this corridor in August 2001 and supplemented in April 2003.

## **5.6.1 SR 101L to Carefree Highway**

### **5.6.1.1 Hydrology**

#### SR 101L to Skunk Creek

This segment stretches from SR101L to Skunk Creek and includes Scatter Wash. The FCDMC prepared the hydrologic analyses for this reach as part of the Arizona Canal Diversion Channel Area Drainage Master Study, Hydrology Report, February 1995. The 100-year peak discharge value at Happy Valley Road was determined to be 2187 cfs. The peak discharge at Pinnacle Peak was determined to be 1,110 cfs. The peak discharge values include 100-year 2-hour retention in accordance with the City of Phoenix standards. The entire watershed has not been developed. Therefore, the hydrologic model may underestimate the existing condition runoff. The final designer should refine the hydrologic models as new information on development becomes available.

Off site flows contributing to I-17 between Skunk Creek and Pinnacle Peak were estimated to range between 300 and 1,200 cfs. The mass grading of adjacent development may significantly impact the flow impacting I-17. The final design should review the grading and drainage plans for adjacent developments before designing the offsite drainage channel. The goal of the DCR was to provide adequate right-of-way for the proposed drainage facilities.

New development has taken place south of the CAP. Continental Homes has constructed a subdivision south of the CAP and north of Jomax Road (west of I-17). Additionally, a commercial facility is being constructed between Jomax Road and Happy Valley, east of I-17 and west of 19th Avenue. The facility will be the corporate office of USAA and is a 577-acre master planned commercial area. Construction of these developments may impact the off-site drainage facilities at I-17.

The USAA facility incorporates several detention/retention basins. The basins collect both off-site and on-site flows, significantly reducing peak flows at I-17 compared to previous estimates.

#### Skunk Creek to the Carefree Highway (SR74)

The portion of I-17 from the Skunk Creek crossing to Carefree Highway TI was analyzed in the Skunk Creek ADMS. The 100-Year 24-hour peak flow rate for Skunk Creek was determined to be 26,513 cfs. This flow was used in the 2-D hydraulic analysis as documented in the *Floodplain Delineation Study for Skunk Creek Between the Central Arizona Project Canal and Happy Valley Road*. The study was prepared in June 2002 for the Maricopa Flood Control District (FCDMC).

This segment has little (if any) offsite flow contributing to the freeway except at the CAP Canal. North of the CAP, runoff travels parallel to I-17. The primary area of concern is the increased onsite flow. Linear detention/retention basins were designed to ensure that the freeway improvements (additional pavement) would not increase storm water runoff.

### **5.6.1.2 Hydraulics**

The proposed drainage system includes extending cross culverts, installation of linear detention basins, a large regional detention basin at Scatter Wash, roadside channels and inlet/storm drain construction. Calculations are preliminary and will require further refinement as more information becomes available during final design. The final designer shall perform all calculations in accordance to the ADOT Roadway Design Guidelines.

The on-site linear detention basins were sized using the Rational Method (10-year 10-minute storm). The contributing basins were determined from the preliminary typical cross sections and using engineering judgment. The large detention basin at Scatter Wash was sized using a modified HEC-1 model.

The proposed channels from the CAP to Scatter Wash were sized using the Manning's equation.

The new storm drain system was not evaluated at this design stage. Additional topographic survey will be required for the design of the storm drain systems. The proposed storm drain system networks are relatively localized and tie into cross culverts where feasible. Most storm drain will be minimum 24-inch diameter. The possible USAA supplemental storm drains (36 and 42 inch pipes) were sized using Manning's equation for circular sections.

### 5.6.1.3 Drainage Improvements

As part of the I-17 improvements, drainage facilities will be added and/or improved to accommodate the off-site flows impacting the highway. The major drainage features from SR 101L to Carefree Highway include:

- Extension of existing cross culverts (where feasible).

- Roadside/collector channels (where required)

- Linear detention basins/ large detention basin at Scatter Wash

- Inlet and storm drains

#### Segment 1 – SR 101L TI to Deer Valley Road

Parcels adjacent to the highway have already been developed. It may therefore be difficult and expensive to obtain additional right-of-way. In order to minimize the amount of right-of-way required, offsite and onsite flows will be collected and routed in a closed conduit system. The system will be sized to ensure that the existing flood hazard for adjacent property owners has not been increased. The conveyance of the pipe system must equal or exceed the conveyance of the existing drainage swales. The storm drains will outlet to the SR 101L offsite drainage system. The capacity of the SR 101L storm drain system will need to be analyzed by the final designer. Existing cross culverts shall be extended..

#### Segment 2 –Deer Valley Road to Skunk Creek

The east half of I-17 will be drained via a storm drain/channel system located adjacent to the right-of-way. The system will originate immediately south of Skunk Creek and extend south to Scatter Wash. This system will be sized to accommodate freeway onsite flow. Offsite flow will be accommodated by the USAA , Vestar, and Roles developments. These developments will prevent storm water runoff from reaching the freeway. The west side of the highway will be drained via a roadside channel/storm drain located between the mainline and frontage road. Each system will outlet to the existing Scatter Wash culvert.

To reduce right-of-way acquisition and provide more flexibility for the commercial site, USAA and Vestar requested that ADOT investigate the option of constructing a closed conduit system from Jomax Road to one-half mile north of Pinnacle Peak Road (Alameda Road). North of Happy Valley Road, the drainage facilities will consist of an independent dual conduit system (ADOT and



USAA). The existing USAA system includes an interim detention basin adjacent to Jomax Road and a 36" storm drain (along I-17 and Happy Valley Road) that will outlet to the intersection of Happy Valley Road and Norterra Parkway.

The Vestar development will construct a channel along Norterra Parkway from Happy Valley Road to the southern boundary of their property. In addition, Vestar will construct an interim earthen channel from their southern boundary (across the Roles property) that routes storm water to the Pinnacle Peak Road RCBC. The Vestar drainage improvements will prevent offsite storm water from reaching I-17. When the Roles parcel is developed they will be responsible for replacement of the interim earthen channel with a permanent drainage facility.

The USAA drainage facilities are required to divert all storm water runoff generated east of Norterra Parkway south along Norterra Parkway to Happy Valley Road. USAA will design their drainage facilities west of Norterra Parkway in accordance with City of Phoenix drainage ordinances (100-year 2-hour facility). Their system will ensure that the only storm water contributing to the freeway is USAA onsite flow (generated west of Norterra Parkway and south of Jomax Road) in excess of the 100-year 2-hour storm event. USAA shall maintain the detention/retention basin at I-17 & Jomax Road until it is relocated to the north or into the ADOT T.I. Parallel drainage systems (ADOT & USAA) will be designed for the 100-year 24-hour storm event. The detention/retention basin is currently drained by a 36-inch pipe to an earthen channel. The channel carries flow to 2-18-inch pipes at the northeast quadrant of the Happy Valley Road TI and to the Norterra Parkway & Happy Valley Road intersection. Based on revised USAA HEC-1 flows, it appears that the 36-inch pipe should be supplemented by an additional 42-inch pipe. ADOT will construct the 42" storm drain along the east side of the I-17 right-of-way. The pipe will pass under Happy Valley Road and continue south (adjacent to Vestar) along the I-17 right-of-way.

Storm water from the east half of the USAA facility cross Happy Valley Road near Norterra Parkway and is routed to the I-17/Pinnacle Peak Road TI. Storm water concentrates in the northeast quadrant of this intersection and is routed south to Scatter Wash through an existing 2- 8' x 7' box culvert under Pinnacle Peak Road. The existing culvert invert is considerably higher than the natural ground at this location. As a result, it appears that a significant ponding area exists in this quadrant. The proposed channel improvements will substantially reduce ponding in the NE quadrant of the I-17 & Pinnacle Peak TI. A concrete channel will convey storm water from Pinnacle Peak Road to Scatter Wash.

The channel on the east side of I-17 at Scatter Wash was sized to convey a maximum capacity of 1,200 cfs. The channel geometry is governed by the minimum channel depth required to outlet onsite flow to the channel, a minimum bottom width of 8 feet, and 2:1 side slopes.

The existing hydrologic models show a flow split at the Scatter Wash crossing of I-17. The existing culverts do not have capacity to pass the 100-year storm event. The combined capacity of the culverts (2 - 8' X 7' and 6' X 7') is approximately 1300 cfs. Approximately 720 cfs is diverted along the east side of I-17 to the Deer Valley TI. Storm water currently flows through the depressed Deer Valley TI and outlets in a southwesterly direction toward SR 101L. Two alternatives are briefly presented below:

Alternative 1 – Construction of a regional offline detention/retention basin near the confluence of I-17 and Scatter Wash would detain the bypass currently breaking out of Scatter Wash. The 100-year 24-hour flood would be intercepted by the existing RCBC's and a proposed 2-6x7 RCBC. The bypass would be allowed to enter the detention basin via an appropriately-sized weir. Preliminary analysis determined that approximately 35 acre-ft of storage is required. The footprint of the basin would be approximately 6.7 acres and would have an average depth of 6

feet and 4:1 side slopes. The exact geometry of the detention basin may change during the final design process.

Alternative 2 – Construction of a small basin shall be at the same location as the larger (Alternative 1) basin. The basin would be sized to ensure that the total amount of storm water runoff generated by the highway is detained and the existing condition flow patterns are maintained (bypass of 720 cfs). The size of this basin is contingent upon obtaining reliable and updated topographic data and shall be performed at final design.

A Memo of Understanding (MOU) has been signed by ADOT, FCDMC, and the COP for construction of Alternative No. 1. Currently, the required parcels west of the freeway are available and the potential reduction in flood hazard is substantial. If the funding is available, construction of the Alternative 1 retention basin system will benefit the region dramatically. FCDMC records show that there are 219 parcels affected by the flooding (i.e. pay flood insurance). Although a set insurance rate does not exist for all properties, an average of \$500 per property per year would yield \$109,500 per year in savings. Over 20 years that would save \$2,190,000 (current dollars). An IGA will be required prior to final design.

Corps of Engineers 404 permits may be required for the proposed improvements to Scatter Wash. The 404 permit requirements need to be coordinated with ADOT Environmental Planning Group as part of the final design process.

Replacement of the 2 – 8' x 7' box culvert through Pinnacle Peak Road to alleviate ponding in the northeast quadrant of the TI is also included in the drainage improvements.

#### Segment 3 – Skunk Creek to CAP Aqueduct

The Bureau of Reclamation constructed overchutes across the CAP aqueduct at Skunk Creek and channelized Skunk Creek to I-17. The existing channelization prevents storm water from breaking out to the east or south, but does not prevent flooding between Skunk Creek and I-17. Future channelization of Skunk Creek may allow a portion of the property on the east side of I-17 to be removed from the floodplain. The widening of I-17 will not adversely impact this area (it is already in a flood hazard area). Onsite storm water generated from the west side of I-17 will be collected in a closed conduit storm drain system and routed south to Skunk Creek.

The Skunk Creek floodplain/floodway has been delineated by FEMA for the area adjacent to the CAP crossing of I-17. Skunk Creek is routed across the CAP via two large overflow structures. The area upstream of the CAP canal adjacent to I-17 was not included in the floodplain of Skunk Creek. The Skunk Creek floodplain does extend to I-17 immediately south of the CAP canal. The current 100-year discharge upstream of I-17 is 26,512 cfs.

#### Segment 4 –CAP Aqueduct to Carefree Highway (SR 74)

Linear detention basins/roadside channels will be constructed between the mainline and frontage road to collect and attenuate on-site flows. This segment has very little off-site flow contributing to the freeway because Skunk Creek flows parallel to I-17. The main concern is the increased on-site flows. Detention basins were designed to ensure that the additional pavement would not increase the storm water runoff. It is recommended that the detention/retention basins be located at each existing cross culvert locations.

Basins should be designed to maximize linear storage and have overflow berms that would allow storm water to flow south without encroaching on the roadway. The depth of each basin will be approximately 2 to 3 feet. The basins will be located between the mainline and frontage roads

Storm water runoff generated by the frontage roads will flow to the ADOT right-of-way and flow parallel to I-17. This flow appears to be less than the existing flow that sheet flows to the ADOT right-of-way. Engineered roadside channels do not exist in this reach. If ADOT requires that storm water does not leave its right-of-way, the frontage road could be designed with curb and gutter, reverse cross slope, or additional right-of-way for drainage channels could be purchased.

A significant drainage issue exists at I-17 along the north side of the CAP aqueduct. The Central Arizona Project Canal (Granite Reef Aqueduct) crosses I-17 at MP 220.38. The existing canal is concrete-lined with a 24-foot bottom width and 1.5:1 side slopes. The canal is 18.5 feet deep (to the top of lining) with a normal water depth of about 16.5 feet.

There are two bridges at this location, southbound I-17 and northbound I-17, as well as frontage road bridges. The existing mainline structures are single span (85.75 feet) AASHTO girder bridges. The abutments for the existing bridges are supported on spread footings. The bottom of the footing is about 14 feet above the canal invert elevation and behind the concrete channel lining. The need for deeper footings for the widening should be evaluated as part of the final design process.

Recent discussions with CAP personnel have confirmed the feasibility of widening these structures. However, review and approval by CAP personnel will be required.

The Flood Control District of Maricopa County (FCDMC) recently prepared a report entitled *Skunk Creek Area Drainage Master Plan*. This study updates the existing hydrologic and hydraulic analyses for the watershed. The existing FEMA FIRM does not show water overtopping I-17. The report states the following: "During the development of the hydraulic modeling for the Water Course Master Plan (WCMP), it was found that a breakout occurs at the CAP Canal and I-17. The breakout results from a backwater caused by limited hydraulic capacity of the Skunk Creek and Sonoran Wash overchutes at the CAP Canal. This breakout results in storm water being diverted west over I-17, and the CAP Canal being overwhelmed by discharges from floods more frequent than the 100-year event. This breakout has the potential to flood existing residences that were previously thought safe, and residences currently under construction. The overwhelming of the overchutes could result in failure of the CAP Canal embankments. The estimated peak discharge over I-17 during the 100-year storm is 6,400 cfs, or about 23 percent of the total flow in Skunk Creek. The estimated average flow depth over I-17 during the 100-year event is 2.5 feet."

The FCDMC is developing design alternatives to mitigate this issue as part of the Skunk Creek ADMP. Results of the FCDMC studies significantly impact the proposed I-17 improvements. ADOT has met with the FCDMC and the City of Phoenix to discuss mitigation requirements for the CAP overchutes. FCDMC consultants are currently developing design alternatives to mitigate the flood hazard identified in the Skunk Creek ADMP. It is anticipated that the FCDMC may complete improvements to the overchutes prior to the I-17 project. The final designer should review the progress of the overchute improvements.

The final designer may need to investigate the option of elevating the frontage road to prevent Skunk Creek from overtopping I-17. This may require additional right-of-way or small retaining walls.

### **5.6.2 Carefree Highway to Black Canyon City**

Most of the improvements for drainage items along I-17 from the Carefree Highway TI to the Black Canyon City TI are associated with the extension of either reinforced concrete box culverts or pipe culverts. These extensions were made with consideration to the clear zone requirements of the corridor. The length of the extension required was based on the greater of the appropriate clear zone or the width of the roadway widening at that particular location.

The northbound and southbound lanes of I-17 closely parallel each other from SR 101L to just north of the New River interchange. The area between northbound and southbound lanes is currently drained by median catch basins connected to small diameter pipe. This pipe conveys flow under either the northbound or southbound lanes to an outfall channel. When the median area is ultimately closed-in with the addition of travel lanes the median catch basins will require removal. The associated connector pipes will either need to be plugged or removed. It has been assumed at this stage of development that it is most practical and economical to plug the pipes.

In a few areas it is necessary to remove either the pipe under the northbound or southbound lanes since closing in the median area creates an undesirable pipe culvert configuration. An undesirable pipe configuration would be a 300-foot long culvert with two sharp angle bends. These bends would require manholes that would ultimately be located in pavement areas. For this situation an extension was added to one pipe to create a straight-through configuration between lanes. This will require cutting a trench for pipe installation or jacking the pipe under I-17. One culvert location where this occurs is located about 1/3 mile south of Deadman Wash.

Two pipe culverts that require the addition of manholes for access maintenance purposes are located about 1/2 mile south of the Table Mesa Interchange. These manholes will be located outside the ultimate pavement area.

Some culvert extensions will require permanent drainage easements or acquisition of right-of-way. Approximately eight culverts between the New River Interchange and the Rock Springs Interchange will likely require an easement or right-of-way to accomplish the necessary improvements.

## **5.7 Section 404 of the Clean Water Act**

Coordination with the US Army Corps of Engineers (COE) will be necessary during project design to ascertain the need for any nationwide or individual permits required under Section 404 of the Clean Water Act. Any deposition of fill material or excavation below the ordinary high water mark will require a permit. Construction activities that will require permits include, but are not limited to, bridge pier construction, culvert installations, replacements and/or extensions requiring excavation and placement of fill material, and roadway embankment widening.

Based upon the field investigations conducted to date, 69 streams and washes are crossed by the recommended design concept alternatives between SR 101L and the New River TI. Of these crossings, 18 streams or washes have been identified as waters of the US. This determination will be submitted to the Corps for concurrence. At this time, the proposed improvements to I-17 will be eligible for a Section 404 Nationwide General Permit No. 14.

## **5.8 Floodplain Considerations**

The following areas have been identified by FEMA as either floodplains or floodways and have been delineated on a Flood Insurance Rate Map (FIRM):

- Scatter Wash

- Skunk Creek
- Central Arizona Project (CAP) Canal
- Deadman Wash
- Moores Gulch
- New River
- Little Squaw Creek
- Agua Fria River

The impacts to each of these crossings are described in detail in Section 5.0, Existing Major Drainage Crossings (pages 9 thru 27), of the *Preliminary Drainage Report, I-17 Widening Study, SR 101L to Black Canyon City TI*, August 2001.

## 5.9 Earthwork

The recommended mainline alternatives assume that the existing profile will be matched for both undivided and divided roadway sections. Detailed mapping was not available during the development of the study; therefore, earthwork estimates are approximate and should be verified during final design.

**TABLE 24 – EARTHWORK SUMMARY**

Area	Excavation (cu. yds.)	Embankment (cu. yds.)	Balance (cu. yds.)
Union Hills Dr to Carefree Highway	198,940	547,830	348,895
Carefree Hwy to New River Rd	504,460	206,585	-297,875
New River Rd to Black Canyon City	637,170	769,210	132,040
<b>TOTAL</b>	<b>1,340,570</b>	<b>1,523,625</b>	<b>183,060</b>

### 5.9.1 Earthwork Factors

The shrink potential for the native soils throughout the project corridor is estimated at approximately 5% to 10%, while the existing embankment materials will be even. The swell potential for the rock material from the road cuts will be approximately 10% to 15%. This swell potential will be influenced by the methods of excavation, the final particle size, and the amount of blending with other soils and/or borrow materials.

Ground compaction during the construction of the roadway embankments will most likely occur within the fine-grained, young sediments deposited on the basin floors and the fine-grained alluvial fans of the lower piedmonts. On average, soils within the project corridor will experience 0.2 feet of ground compaction prior to earthwork activities.

### 5.9.2 Preliminary Cut Slope Recommendations

Stability of the cut slopes in the bedrock encountered at the cut areas will be dependent upon fracture orientations and weathering conditions encountered within the rock mass of the Tertiary basalt flows and the Proterozoic metasedimentary and metavolcanic rocks. The stability of the slopes cut into the Tertiary and Quaternary sediments will depend predominantly upon the overall rock/soil mass strength

due to the general absence of discontinuities within these young deposits. A more detailed study, on a cut by cut basis, should be performed for final design. For preliminary slope design, we recommend a slope of ½:1 for the basalt flows and metamorphic rocks and 1:1 slopes for the younger deposits.

No discontinuity analysis or rockfall simulations have been performed within the scope of this study. However, cut design and recommended rockfall containment ditch widths should be based on a detailed discontinuity analysis, the Ritchie Criteria (1963) and in accordance with ADOT Standard Drawing C-02.10.

### **5.9.3 Preliminary Fill Slope Recommendations**

All non-stabilized fill slopes should be constructed no steeper than 2(h):1(v) in accordance with ADOT Standard Drawing C-02.10. Construction of fill slopes should be in accordance with Section 203-10 of the ADOT Standard Specifications. Should steeper slopes be required within drainages or near existing canal structures, use of mechanically stabilized embankments is recommended.

In areas of potential excessive fill erosion, treatment of slopes with geosynthetics should be considered.

### **5.9.4 Potential Material Sources**

A review of borrow pit information available at ADOT's Material Section revealed a large number of pits that have been historically used by ADOT along the project corridor. However, a very small number of these pits remain active as of the date of compilation of the data by ADOT. The contractor will be responsible for identifying a suitable borrow site with ADOT environmental clearance.

### **5.9.5 Preliminary Bridge Foundation Design**

Most of the existing bridge structures along the alignment are founded on spread footings. Many structures that cross waterways utilize driven H-piling.

Based on review of boring logs on the as-built plans, it appears that structures that will not be exposed to potential scour may be founded on spread-type footings or drilled shaft foundations. Depth to competent soil or bedrock, right-of-way constraints or construction conflicts with existing structures may be the determining factor to be the best alternative.

Based on the as-built plans and foundation data information, structures that will potentially be exposed to storm events and scour should be founded on drilled shafts, rock sockets or spread-type footings. Where depth to bedrock is relatively shallow, rock sockets or spread-type footings keyed into bedrock would likely be the best alternatives for support of the structures. If spread-type footings are utilized, additional lateral resistance may be achieved by using rock bolts. Depending on the depth to bedrock or competent soil, spread-type footings may prove to be uneconomical due to the amount of excavation that would be required. In addition, there may not be sufficient right-of-way or clearance from existing structures for spread-type footings to be feasible. Depending on a hydrologic analysis, a box culvert type structure bearing on shallow streambed and alluvial soils or bedrock may be a viable alternative if a cutoff wall or some other type of scour protection is utilized. Test drilling performed at each foundation element during the final investigation should clearly indicate which foundation type is best suited to this location.

### **5.9.6 Potential Geologic Hazards**

It should be noted that all these discussions are very general in nature and that more detailed, site-specific investigations are required to assess potential hazards at particular locations.

### **5.9.7 Flooding Hazards**

The hydrologic analysis of the highway corridor is not considered part of the geotechnical investigation. However, it should be noted that areas of the project alignment which intercept and/or parallel the existing major rivers (Agua Fria and New River) and tributary creeks (Little Squaw and Skunk Creeks and Deadman Wash) are susceptible to flooding, flash-flooding and erosion. Historical flooding in the area of the project has resulted from the overflow of these drainage systems during regional storms in winter and late summer to early fall. Intense, localized thunderstorms that occur during the summer and early fall cause flash-flooding in the areas of the smaller tributaries of these major drainage systems. Bank erosion, in this case of fill areas daylighting in existing drainage channels, may be caused by large volume, high velocity flows from large flood events.

### **5.9.8 Debris Flows and Rockfalls**

Debris flows and rockfalls have been likely to occur within the deep slopes of the mountainous terrain within the project area during periods of heavy precipitation. Although the hazard for debris flows exists within the area, the highway alignment remains on the flanks of the steeper terrain therefore reducing the hazard posed by debris flows. Detailed geologic mapping of the project area should be performed to identify and/or mitigate the potential risk posed by this hazard. Local rockfall, however, is considered a potential hazard in the areas of the roadway cuts. This hazard should be investigated on a cut by cut basis during the final design phase of the project.

### **5.9.9 Collapsible Soils**

Collapsible soils can occur within fine-grained deposits usually encountered in young alluvial sediments. Due to the proximity of the proposed alignment to mountain flanks and their associated alluvial fans, the potential for collapsible soils exists. Further investigation and detailed mapping should be performed to determine the areal extent of the hazard as well as to better characterize these deposits for final roadway design.

### **5.9.10 Expansive Soils**

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content, potentially caused by precipitation or droughts. Refer to the geotechnical assessment report for areal distribution of medium to high shrink/ swell soils. Areas along the alignment may have deposits of expansive clays that may require mitigation in the form of over excavation or other mitigation/stabilization techniques. The noted areas should be studied in more detail during final investigations to identify the limits and type of treatment that may be required.

## **5.10 Constructibility and Traffic Control**

### **5.10.1 General**

Existing highway movements and access must be maintained during construction. Because there are no alternate routes, closure of Interstate 17 will not be allowed other than for the short periods of time. Final construction sequencing/phasing will be determined during final design. Traffic will be managed using detailed traffic control plans and by procedures and guidelines specified in the Millennium Edition of the Manual on Uniform Traffic Control Devices (MUTCD), Revision 1, and by the Arizona Supplement to the Millennium Edition of the MUTCD.

Significant construction activities that disrupt traffic are to be performed during off-peak hours. Efforts to minimize the duration of construction should be made during final design. Existing freeway movements and access to and from ramps must be maintained during construction. Adjacent ramps should not be closed simultaneously; ramps for alternating cross roads must be open at all times. Other methods of

reducing traffic impacts during construction, such as phasing the improvements so the entire length of the project is not under construction at one time, will be evaluated during the final design phase of the project.

The phasing of construction for the recommended improvements generally can be accomplished in two phases. The first phase includes widening to the inside along the freeway. To maintain traffic during this phase of construction, the width of the inside shoulder may be reduced, but a useable (10 foot) right shoulder must be maintained. Temporary concrete barrier is recommended to protect the work area from freeway traffic.

The second phase of construction will shift traffic to the newly-constructed inside lanes and will complete the widening to the outside with reconstruction of the gores and ramps as necessary.

Construction of the full typical section will require reconstruction of the interchange bridges at Pinnacle Peak Road, Happy Valley Road, and Carefree Highway. The replacement of these bridges is not part of this study; however, costs are included for the replacement of the Pinnacle Peak and Happy Valley bridge structures.

Access to adjacent properties shall be maintained during construction.

#### **5.10.2 Begin/End Lanes at North End of Project**

In anticipation of construction of additional lanes to the north of these project limits, the widening layout shown on the plan sheets in Appendix C does not taper to match existing lane configurations. Rather, the 4+0 section is squared off in anticipation of being matched by projects to the north.

#### **5.10.3 HOV Facility Signing**

ADOT has established a conventional method of signing a continuous left side HOV lane. This method is recommended for the corridor. For the length of the corridor, an R3-14 sign panel would be mounted above the HOV lane at each underpass structure. Additionally, R3-11 signs will be placed periodically throughout the corridor to confirm hours of operation.

#### **5.10.4 HOV Lane Begin and End Conditions**

The operations of beginning or ending an HOV facility have been addressed by many DOTs around the country. The begin condition is usually designed to start the HOV lane to the left of the general use lanes with appropriate advance signing. This is recommended for I-17. To end a left-side HOV lane, ADOT has typically merged the HOV lane into the general use lanes. The roadway plans in Appendix C depict striping schematics for the begin and end conditions for the HOV lanes near the New River TI.

### **5.11 Interchanges**

Widening and/or improvements to the I-17/SR 101L interchange and the I-17/Table Mesa interchange were considered as part of this study. Additionally, the diamond-type northbound exit ramp at Deer Valley Road will be removed and replaced by a loop ramp in the northeast quadrant of the TI. Plan sheets for the I-17/SR 101L and Deer Valley interchange recommendations are included in Appendix C. Plan and profile sheets for the Table Mesa interchange alternatives and recommendations are in Appendix D.

### **5.12 Utilities**

During final design, each utility company will receive and review the preliminary design for this project and develop plans for any relocations and/or adjustments.



Using as-built plans, utility plans supplied by the utility companies, and the conceptual plans developed for the I-17 widening as references, it is anticipated that utility relocations and adjustments will be necessary. The most extensive utility relocation will involve the AT&T fiber optic line that runs along the existing R/W on the west side of I-17 from Happy Valley Road to Anthem Way. It appears that the portion of the line from Happy Valley Road to Carefree Highway will need to be relocated due to the acquisition of new R/W associated with constructing drainage channels and new frontage roads.

Other potential utility conflicts include telephone on the west side north of the Deer Valley TI, between the Pinnacle Peak and Happy Valley Road TIs, and on the east side south of the Carefree Highway TI.

Potential conflicts with overhead power and fiber optic include lines on the west side between MP 219 and 221.8, on the east side between MP 221.8 and Carefree Highway TI, on the east side between MP 219.7 and 219.8, and crossing the mainline between the old rest areas south of the Anthem TI. Power lines crossing I-17 where frontage roads are to be added or relocated outward will likely require that the poles be relocated outward, including crossings near MP 218.9, 219.3, 220, and 221.8.

APS is planning to construct a new 230 kV overhead power line in the project area, to be activated in 2008. The line will cross I-17 south of Happy Valley Road and proceed north on the west side of I-17 to north of Dixileta, then depart from the I-17 alignment and proceed north and west. The existing 69 kV line will be underhung with the new line. APS has met with ADOT and the City of Phoenix and plans to site the line to accommodate future I-17 widening and new TIs in this area.

No impacts to the transmission towers at the Table Mesa TI are anticipated.

## **5.13 Structures**

### **5.13.1 Summary of Recommended Strategy – SR 101L to Carefree Highway TI**

The recommended alternative for this segment involves widening I-17 to accommodate five general use lanes, one HOV lane with buffer, auxiliary lanes, and shoulders in both northbound and southbound directions.

The **Yorkshire Drive TI UP** and the **Rose Garden Lane TI UP** require no structural modifications to accommodate the recommended alternative roadway section. (Median barrier transitions and outside barrier transitions around substructure units are required but are not considered structural modifications.)

The **four mainline bridges within the I-17/SR101L TI** require widening on the outside. The existing structures were all constructed using CIP concrete boxes. Using the same structural system for widening as the existing bridges maximizes both structural and aesthetic compatibility. Therefore, bridge widening should be performed using matching, CIP concrete box construction. Uniform width sections can be implemented at three of the four structures. However, a varying width widening appears to be required for I-17 SB over North Frontage Road (NFR). To avoid vertical clearance problems arising from the required falsework during construction, the NFR can be used as a detour to carry SR101L westbound traffic after widening over the NFR is completed. A similar detour using the SFR will not be possible due to the existing bridge span configurations.

The dual structures at the **Deer Valley Road TI OP** require widening on both sides, via median infill between the bridges and widening on the outside of both bridges. Bridge widening can be performed such that the current existing minimum vertical clearance of 15'-8" is maintained. If additional vertical clearance is deemed necessary, the profile of Deer Valley Road may be lowered in order to provide it. Alternatively, a new replacement structure for the TI OP can be constructed and the existing I-17 profile and/or structure depth designed to provide the required clearance.

The structures at the **Pinnacle Peak Road TI UP** and the **Happy Valley Road TI UP** require replacement. The interior spans of their four-span arrangement are too short to accommodate the recommended roadway section, thus the exterior piers conflict with the outsides of the I-17 roadway northbound and southbound. According to a September 1998 report, *Bridge Candidate List for the Highway Bridge Replacement and Rehabilitation Program*, the **Happy Valley Road TI UP** is eligible for ADOT/USDOT/FHWA bridge replacement funds.

Both pairs of dual waterway bridges (**Skunk Creek, CAP**) require widening on both sides. Median infill alone does not provide sufficient deck width, thus requiring outside widening as well. The hydraulic openings must be checked for potential freeboard reduction due to widening cross slope fall. At Skunk Creek and the CAP, adjoining east and west frontage road bridges are available for potential use as traffic detours during key stages of bridge widening construction. At Skunk Creek, insufficient horizontal clearance between the existing mainline and frontage road structures requires relocation of the frontage road bridges to accommodate the mainline typical section (note that the future interchange at Jomax Road will likely reconstruct the frontage road bridges over Skunk Creek). At the CAP canal crossing, the existing SB frontage road bridge can be widened to the outside to accommodate the new frontage road alignment. Due to the mainline widening cross slope fall, grade elevation differences between the SB frontage road and the widened SB mainline structure will result at the outside traffic barrier. Field verification to confirm that sufficient horizontal clearance exists between the SB mainline and SB frontage road structures will be needed. The new alignment for the NB frontage road is offset approximately 35 feet from the existing NB frontage road bridge. As a result, a widened structure would have a large portion of unnecessary deck. The existing structure should be removed and a new structure built to accommodate the proposed NB frontage road alignment. Based on current conditions, in-kind, cast-in-place slab bridges can be used for all widenings at both locations. Possible bridge types for the new structures include cast-in-place slab or precast voided boxes.

#### **5.13.2 Summary of Recommended Strategy – Carefree Highway to New River TI**

The recommended alternative for this segment involves widening I-17 to accommodate four general use lanes, one HOV lane with buffer, auxiliary lanes, and shoulders in both northbound and southbound directions.

The structure at the **SR74 Carefree Highway TI UP** requires replacement. The interior spans of its four-span arrangement are too short to facilitate the recommended alternative roadway section. The exterior piers conflict with the outsides of the I-17 roadway northbound and southbound. In addition, the structure has been rated functionally obsolete according to a Structure Inventory and Appraisal report performed by ADOT in February, 1997. The span arrangement of the new replacement structure should be configured to accommodate the recommended roadway section.

According to a September 1998 report, *Bridge Candidate List for the Highway Bridge Replacement and Rehabilitation Program*, the SR74 Carefree Highway TI UP is eligible for ADOT/USDOT/FHWA bridge replacement funds. The reconstruction of the Carefree Highway TI is addressed by a separate project, with construction programmed for 2005.

The **Pioneer Road TI UP** requires modification. Sufficient bridge opening widths are available by removing the foreslopes of the abutments. Medium height retaining walls may be required if geotechnical conditions pose potential slope instability risks. Median infill widening of I-17 creates a conflict in each direction. The median pier foundation will be exposed and conflict with widening of the southbound lanes. Minimum vertical clearance will be impaired by widening of the northbound lanes. Several alternatives are available for evaluation during final design to resolve these problems, including but not limited to one or more of the following:

- The southbound and northbound construction centerlines can be spread laterally in the vicinity of the bridge to create space for a special median barrier and to clear the spread footing.

- The median pier can be reanalyzed and converted from a pier on a 9' x 16' spread footing to a wall pier on, say, a 4.5' x 32' strip footing; or converted to deep foundations.
- The minimum vertical clearance northbound can be preserved by adjusting the profile grade line of the northbound lanes in the vicinity of the bridge, or by introducing a crown line and draining the resultant median gutter line.
- The relatively lightweight steel bridge (est. 650 tons) can be raised by jacking the superstructure, constructing higher abutment /pier seats, and replacing bearings.

Both pairs of dual waterway bridges (**Deadman Wash and New River**) and the dual overpass structures of the **New River TI OP** require widening on both sides. Median infill alone does not provide sufficient deck width, thus requiring outside widening as well. The hydraulic openings must be checked for potential freeboard reduction due to widening cross slope fall.

Geometric dissimilarities between the southbound bridge – the original 1948 two-directional bridge widened in 1982 – and the northbound bridge at Deadman Wash will require special attention during final design. The dissimilarities are as follows:

- Horizontal – Although the structures are of the same type and span arrangement, they do not align. The southbound bridge is about 25 feet farther south than the northbound bridge.
- Vertical – The uphill southbound bridge (average elevation = 1735.5; grade = +0.125%) is 4.9 feet lower than the downhill northbound bridge (average elevation = 1740.4; grade = -0.2586%).
- Cross slope – The southbound bridge retains its original 1.75-inch parabolic crown projected at -1.50% cross slope both sides with 1982 widening. The northbound bridge has -1.50% cross slope. The vertical difference increases if the median side cross slope of the southbound bridge is retained with median infill widening.
- Skew – The southbound bridge has skew = 0 and the northbound bridge has skew = 20° LT.

The simplest way to overcome the dissimilarities is to connect the east edge of the southbound substructure units with the west edge of the northbound substructure units – parallel chords. A special median barrier detail can be designed to accommodate the vertical difference.

The **Anthem Way TI UP** requires no structural modifications to accommodate the recommended alternative roadway section.

### **5.13.3 Summary of Recommended Strategy – New River TI to Black Canyon City TI**

The recommended alternative for this segment involves widening I-17 to accommodate four general use lanes and shoulders in both northbound and southbound directions.

The structures at the **Table Mesa Road TI UP** and the **Black Canyon TI OP** (Old SR 69) require replacement. The center spans of the Table Mesa bridges' three-span arrangement are too short to accommodate the recommended roadway section; the piers conflict with the outsides of the proposed roadway sections. At the Black Canyon TI OP, the bridges are too narrow to accommodate the recommended mainline section. In addition, the Black Canyon structures have been rated functionally obsolete according to a Structure Inventory and Appraisal report performed by ADOT in April 1997. Span arrangements for the replacement structures will need to be configured to accommodate the new roadway sections.

All three pairs of dual waterway bridges (**Moore's Gulch, Little Squaw Creek, and Agua Fria River**) require widening on one side – outside at Moore's Gulch and Little Squaw Creek; inside at Agua Fria River. The hydraulic openings must be checked for potential freeboard reduction due to widening cross slope fall. According to an August 1998 report on special deck inspections, the Little Squaw Creek Bridges southbound/northbound exhibit considerable deck deterioration. Consideration should be

given to replacement with new wider bridges if such deck deterioration renders the bridges to have negligible remaining useful life.

The **Rock Springs TI UP** bridges require modification. Sufficient bridge opening widths are available by removing the foreslopes of the abutments – the east abutment of each bridge. Medium height retaining walls may be required if geotechnical conditions pose potential slope instability risks. The potential locations are the median side of the southbound bridge and the outside of the northbound bridge – the east abutment of each bridge.

The **Mud Springs UP** requires no structural modifications to accommodate the recommended alternative roadway section.

Replacement of the **Black Canyon City TI OP** structures is recommended because the existing bridge openings, only 34 feet wide by 14 feet high, provide inadequate minimum lateral clearance and minimum vertical clearance. There is sufficient evidence of vehicle impact danger both laterally to the columns and vertically to the slab soffit on both the eastbound approach to the southbound bridge and westbound approach to the northbound bridge.

## **5.14 Preliminary Pavement Design**

Pavement improvement for most of the study segment may consist of various surface treatments including milling and replacement, overlays, and friction course treatments. Additionally, areas in which the drainage cannot be maintained by using the existing crown may need total reconstruction. If the existing pavement is to be reused and overlaid, consideration must be given to existing cracks that could propagate from the existing pavement through the overlay. Reflective cracking is especially prevalent when overlaying Portland cement pavements; in this case, the use of a geomembrane is required to attempt to stop the propagation of the cracks to a future surface treatment.

Based on discussions with ADOT construction and maintenance staff, ADOT prefers a rigid pavement section from SR 101L to the Carefree Highway TI. From north of the Carefree Highway TI to the northern project limit, a flexible pavement is recommended. ARFC is included over both rigid and flexible pavements throughout the study limits. The maximum pavement section for the study area is estimated at 19 1/2 inches for flexible pavement (9 inches of asphaltic concrete over 10 inches of aggregate base with 1/2 inch ARFC) and 19 inches for rigid pavement (14 inches of doweled Portland cement pavement over 4 inches of aggregate base with one inch ARFC).

The cost estimate does not include the use of select material and assumes a required new section or reconstruction to meet structural number requirements. If existing pavement is re-used, reconstruction of existing pavement should ensure that current superelevation standards are met. The superelevation on a number of the existing horizontal curves is less than the AASHTO-recommended minimums.

## **5.15 Design Exceptions**

Non-conforming features will be upgraded as part of this project to meet current standards as noted in Chapter 3. Design exceptions will be requested for the remaining non-conforming features as discussed in Chapter 3.

In addition, design exceptions for Design Speed and Horizontal Curvature will be required for the new northbound exit loop ramp at Deer Valley Road.